Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Marsh Bird Surveys, Topock Gorge
2012 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

June 2013

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Lower Colorado River
Multi-Species Conservation Program

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Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

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ACRONYMS AND ABBREVIATIONS

CD	compact disc
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
NWR	National Wildlife Refuge
Reclamation	Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service

Symbols

%	percent

CONTENTS

Tables

Figures

Attachments

ABSTRACT

In 2012, surveys for marsh birds were conducted by the Lower Colorado River Multi-Species Conservation Program. Surveys were conducted during March, April, and May in Topock Gorge (see figures 1 and 2). Yuma clapper rail (*Rallus longirostris yumanensis*), California black rail (*Latteralus jamaicensis coturniculus*), least bittern *(Ixobrychus exilis*), and Virginia rail (*R. limicola*) were detected.

INTRODUCTION

The Yuma clapper rail (*Rallus longirostris yumanensis*) was listed as an endangered species by the U.S. Department of the Interior in 1967 (U.S. Department of the Interior 1967) and is currently listed under the Endangered Species Act regulated by the U.S. Fish and Wildlife Service (USFWS). The species is presently listed as threatened in California and is a species of special concern in Arizona (Arizona Game and Fish Department 2006; California Department of Fish and Game 2011). The California black rail (*Laterallus jamaicensis coturniculus*) is a migratory nongame bird of management concern (USFWS 1995). In California, this species is listed as threatened and is also listed as a species of special concern in Arizona (Arizona Game and Fish Department 2002; California Department of Fish and Game 2011). Least bittern (*Ixobrychus exilis*) is a species of special concern in Arizona and California (Arizona Game and Fish Department 2001; Sterling 2008). It is listed by the USFWS as a migratory nongame bird of management concern (USFWS 1995).

Conservation measures in the Habitat Conservation Plan of the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) provide for monitoring and research of the Yuma clapper rail, California black rail, and least bittern (LCR MSCP 2004). Surveys for these three covered species are conducted in existing habitat as part of system-wide monitoring and at sites prior to and after creation of marshland habitat (LCR MSCP 2004).

Research into the habitat requirements of covered marsh birds includes a recently completed study under the direction of Dr. Courtney Conway. In June 2008, the Bureau of Reclamation (Reclamation) entered into a Cooperative Agreement with the University of Arizona and the U.S. Geological Survey. A study was initiated in a newly created marsh at Imperial National Wildlife Refuge (NWR) to document vegetation and depth of water used by marsh birds over a 2-year period, correlating the range of hydrologic conditions and plant associations preferred by California black rails, Yuma clapper rails, least bitterns, and other marsh bird species encountered. The results of this study are now being used to develop new marsh habitat under the LCR MSCP at the Laguna Division Conservation Area near Yuma, Arizona, and to manage existing and created wetlands at Cibola NWR (Nadeau et al. 2011). More information about these sites, as well as recent reports, can be found at www.lcrmscp.gov.

BACKGROUND

Using broadcast vocalizations, Gibbs and Melvin (1993) found that three visits to a wetland were adequate to determine the presence or absence of all target species with 90 percent (%) certainty. Up to a 25% change in population abundance of water birds can be detected over a 10-year monitoring period by surveying

40–80 mini-routes on 2–3 occasions annually (Gibbs and Melvin 1997). Along the lower Colorado River at Mittry Lake (north of Yuma, Arizona), Conway et al. (1993) used radio telemetry in conjunction with playback recordings of Yuma clapper rail to determine detection rates. They determined that marked birds exhibited a year-round response rate of 19.2%. During the early breeding season in March and April, the response rate was 40%. During the late breeding season in May through July, the response rate was 20%. The maximum number of responses detected during any one survey period provides the minimum number of birds present during the survey year.

Reclamation began conducting surveys in the Topock Gorge portion of the Havasu NWR in 1996 using a protocol specifically for Yuma clapper rail (figure 2). These surveys were part of a basin-wide multi-partner effort to monitor the population of Yuma clapper rails with the ultimate goal of delisting the species (USFWS 1983). In June 2000, Reclamation conducted surveys for the California black rail in Topock Gorge and Topock Marsh as part of a one-time basin-wide survey; no black rails were found at either location (Conway et al. 2002).

Conway and Nadeau (2006) found that broadcasting calls of multiple species of marsh birds does not compromise the vocalization probability of any one species. Since 2006, Reclamation has participated in the National Marsh Bird Monitoring Program (http://ag.arizona.edu/research/azfwru/NationalMarsh Bird/index.htm), which involves surveying several species simultaneously using taped recordings of the species calls (Conway 2005, USFWS 2006). The goal of the national program is to estimate population changes in marsh birds using standardized, repeatable survey methods (Conway and Nadeau 2006). This goal parallels Reclamation's requirement for long term monitoring of created habitat to determine if it is suitable for species covered by the LCR MSCP and if the species are present. All Reclamation personnel involved with marsh bird surveys have attended and successfully completed the Marsh Bird Training Workshop presented by Dr. Courtney Conway.

SURVEY AREA

Topock Gorge is located along the lower Colorado River between Needles, California, and Lake Havasu City, Arizona, in the Havasu NWR and is also located in Reach 3 (figures 1 and 2). The survey route in Topock Gorge runs from River Mile 233 to just past River Mile 218, a distance of 15.3 miles (24.6 kilometers). Marshes are located on both the California and Arizona sides of the river with the largest marsh complexes on the Arizona side just north and south of Blankenship Bend (River Mile 222.5). The predominant vegetation consists of California bulrush (*Schoenoplectus californicus*), southern cattail, and common reed (*Phragmites communis*) interspersed with stands of saltcedar (Tamarix sp.) and coyote willow (*Salix exigua*). There are 52 survey points in Topock Gorge.

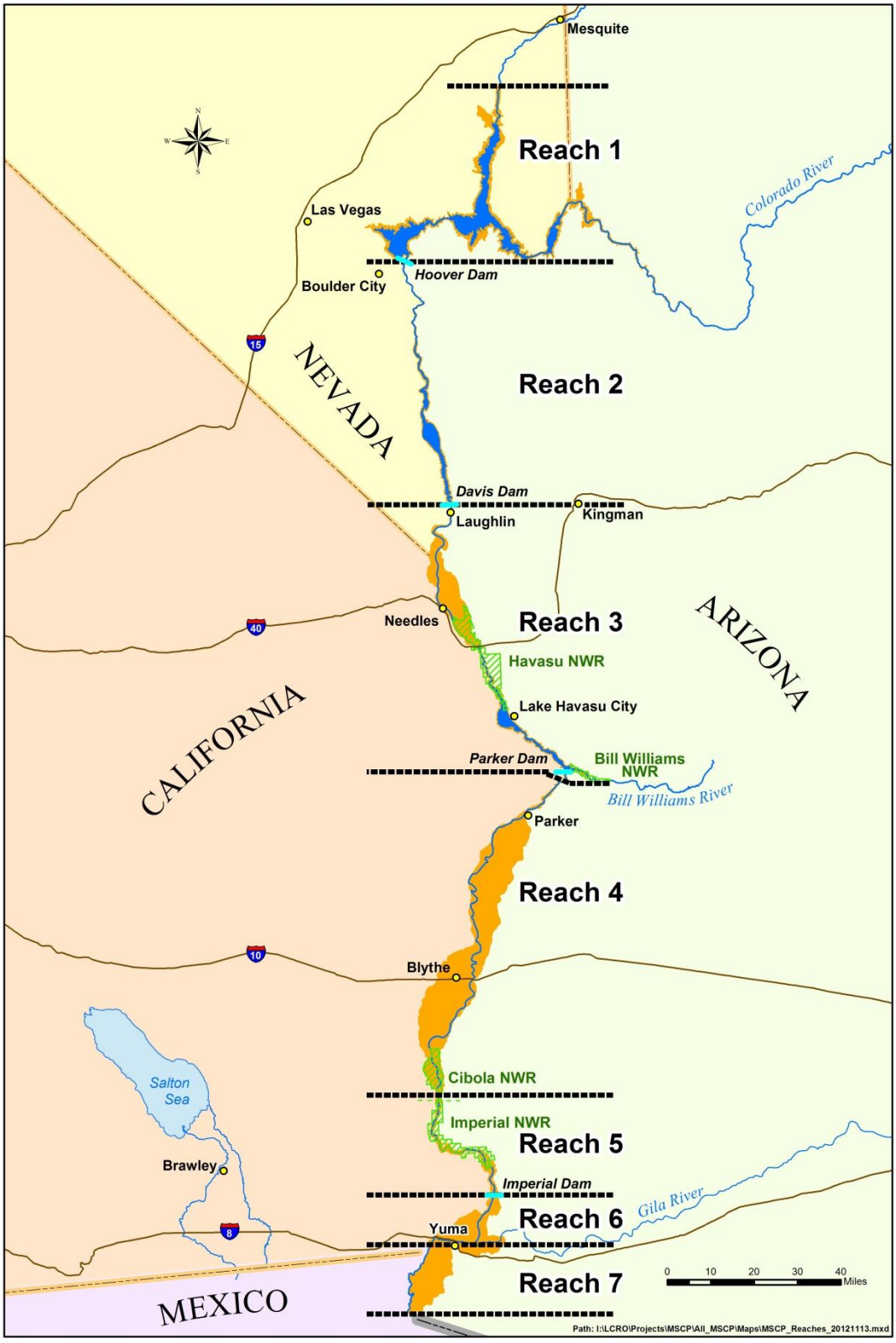

Figure 1.—LCR MSCP area.

Figure 2.—Topock Gorge.

METHODS

Using a standardized protocol from the National Marsh Bird Monitoring Program, surveys for the California black rail, least bitten, Virginia rail, and Yuma clapper rail were performed between March 15 and May 31 (USFWS 2003, 2006; Conway 2009). Three surveys were conducted, and a standardized survey form was used to record the date, start and end time, location, route, observers, environmental data, and other comments as well as selected marsh birds

encountered, their responses, and direction and distance from the survey point (attachment 2). The locations and numbers of pied-billed grebe (*Podilymbus podiceps*), sora (*Porzana carolina*), and common gallinule (*Gallinula galeata*) were also recorded. The number of marsh wren (*Cistothorus palustris*) observed at each point was also noted.

Surveys began 30 minutes before sunrise and continued until marsh birds ceased calling, usually by 10:00 a.m. Surveys ceased when the wind speed was greater than 20 kilometers per hour because the detection of birds was impaired due to noise from rustling vegetation. Surveys are not conducted during periods of sustained rain or heavy fog (Conway 2009).

Portable compact disc (CD) players with amplified speakers were used to broadcast calls of the four selected species. The CD consisted of 5 minutes of silence followed by 30 seconds of selected calls and 30 seconds of silence for each of the species. Specific calls used were "kicky-doo" and "grr" for black rail, "coo" and "kak" for least bittern, "grunt," "ticket," and "kicker" for Virginia rail, and "clatter," "kek," and "kek-burr" for clapper rail. Calls were played at a volume of 80–90 decibels measured 1 meter from the speakers.

Birds encountered before or after the official 9-minute survey period were also noted on the survey form (attachment 2). Maps of the survey sites showing the general location of the birds encountered were marked, and Universal Transverse Mercator coordinates were taken using a Global Positioning System for the survey sites. Surveys in Topock Gorge were conducted using a motorized boat.

RESULTS

Surveys in Topock Gorge were conducted March 20–23, April 17–20, and May 19–22 (table 1). Survey points 21 and 46 were not visited during the March survey due to low water levels. Yuma clapper rails, least bitterns, and Virginia rails were detected during all three surveys. California black rails were only detected during the March survey. In March, 23 Yuma clapper rails, 1 least bittern, 3 California black rails, 12 Virginia rails, 2 soras, 20 pied-billed grebes, and 5 common gallinules were detected during the survey period. During the April surveys, 54 Yuma clapper rails, 18 least bitterns, 8 Virginia rails, 3 soras, 67 pied-billed grebes, and 9 common gallinules were detected. The May surveys resulted in detections of 53 Yuma clapper rails, 27 least bitterns, 6 Virginia rails, 57 pied-billed grebes, and 6 common gallinules. All bird species observed during the surveys were noted and compiled in attachment 1.

Table 1.—Topock Gorge marsh bird survey results, 2012

	March 20–23							April 17–20							May 19–22						
Point	CLRA	LEBI	BLRA	VIRA	SORA	PBGR	COGA	CLRA	LEBI	BLRA	VIRA	SORA	PBGR	COGA	CLRA	LEBI	BLRA	VIRA	SORA	PBGR	COGA
1	0	0	0	0	0	1	0	0	0	0	0	0	4	0	0	1	0	0	0	2	0
2	1	0	0	1	0	1	0	4	0	0	1	0	2	0	2	0	0	1	0	1	0
3	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
4	0	0	0	0	0	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	3	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0
8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	0	0	0	0	0
10	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
12	0	0	0	0	0	2	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
15	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	2	0
16	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
17	0	0	1	0	0	1	0	2	2	0	0	0	4	1	2	0	0	2	0	2	0
18	0	0	1	0	0	0	0	1	0	0	0	0	3	0	2	0	0	0	0	0	0
19	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	1	0
20	0	0	0	0	0	0	0	1	0	0	1	0	1	0	2	1	0	0	0	3	0
21								1	0	0	1	0	1	0	3	2	0	1	0	0	0
22	5	0	1	1	0	0	0	1	2	0	1	0	0	0	3	1	0	1	0	0	0
23	0	0	0	0	0	0	0	1	0	0	0	0	5	0	3	3	0	0	0	2	1
24	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	3	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
26	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
27	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
28	2	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
30	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
31	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
32	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
34	0	0	0	1	0	0	0	0	0	0	2	1	1	0	4	2	0	0	0	1	0
35	1	0	0	0	0	0	0	4	0	0	0	0	3	0	1	1	0	0	0	2	0
36	1	0	0	2	0	0	0	4	0	0	0	0	1	0	3	0	0	0	0	0	0
37	0	0	0	1	0	0	0	8	0	0	0	0	0	0	1	0	0	0	0	0	0
38	3	0	0	1	0	0	0	3	0	0	0	0	5	0	3	1	0	0	0	1	0
39	1	0	0	0	0	1	0	4	0	0	1	0	2	3	1	4	0	0	0	4	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
42	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0
43	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	3	1
44	3	0	0	0	0	0	1	0	0	0	0	0	2	0	2	0	0	0	0	1	1
45	2	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	1
46								3	4	0	0	0	0	3	2	0	0	0	0	4	0
47	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1
48	1	0	0	0	1	0	3	3	0	0	0	0	1	1	1	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	1	0
50	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	5	0	0	0	1	0
51	0	0	0	0	0	1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0
52	3	0	0	0	0	1	0	1	0	0	0	0	1	0	3	1	0	0	0	4	0
Total	23	1	3	12	2	20	5	54	18	0	8	3	67	9	53	27	0	6	0	57	6

CLRA – Yuma clapper rail, BLRA – California black rail, LEBI – least bittern, VIRA – Virginia rail, SORA – sora, PBGR – pied-billed grebe, and COGA – common gallinule.

DISCUSSION

Topock Gorge

All three covered species were encountered during surveys in Topock Gorge. Surveys conducted in April detected 54 Yuma clapper rails; this was the highest of all three surveys. There were 53 Yuma clapper rails detected in May and only 23 in March. Least bittern detections were highest in May with 27 detected. The highest detections of Virginia rails were 12 during the March survey period (see table 1). Three California black rails were detected in March. California black rails were not detected during the other survey periods this year (see table 1). California black rail numbers have varied in Topock Gorge since first detected in March and April 2007; one was detected during each survey. There were no detections in 2008. In 2009, one was detected in March, three in April, and one in May. One California black rail was detected in April 2010. In 2011, seven were detected in March, one in April, and three in May (figure 3).

During the 2012 survey season, Yuma clapper rails were detected at 33 sites, California black rails at 3 sites, least bitterns at 23 sites, and Virginia rails at 13 sites (see table 1). Yuma clapper rails, least bitterns, soras, pied-billed grebes, and common moorhen were distributed throughout Topock Gorge. Virginia rails were found primarily south of Devil's Elbow. California black rails were detected above and in Blankenship Bend (see figure 2).

In 2011, there were 76 Yuma clapper rails detected during the April surveys. This was the highest count for Reclamation surveys since 1996 (figure 4). Reclamation implemented marsh bird survey protocols in 2006. Prior to 2006, surveys were directed at Yuma clapper rails, and the other marsh bird species encountered were noted on the survey sheets. Starting in 2006, calls for California black rail, least bittern, and Virginia rail were incorporated into the survey protocol (Conway 2005).

RECOMMENDATIONS

These surveys are implemented each year as part of the LCR MSCP. Surveys of existing habitat should be continued as part of system-wide monitoring (LCR MSCP 2004).

The relationship between water levels in Topock Gorge and the amount of marsh area that is inundated or exposed should be investigated to determine whether there is a relationship between numbers of marsh birds and available habitat.

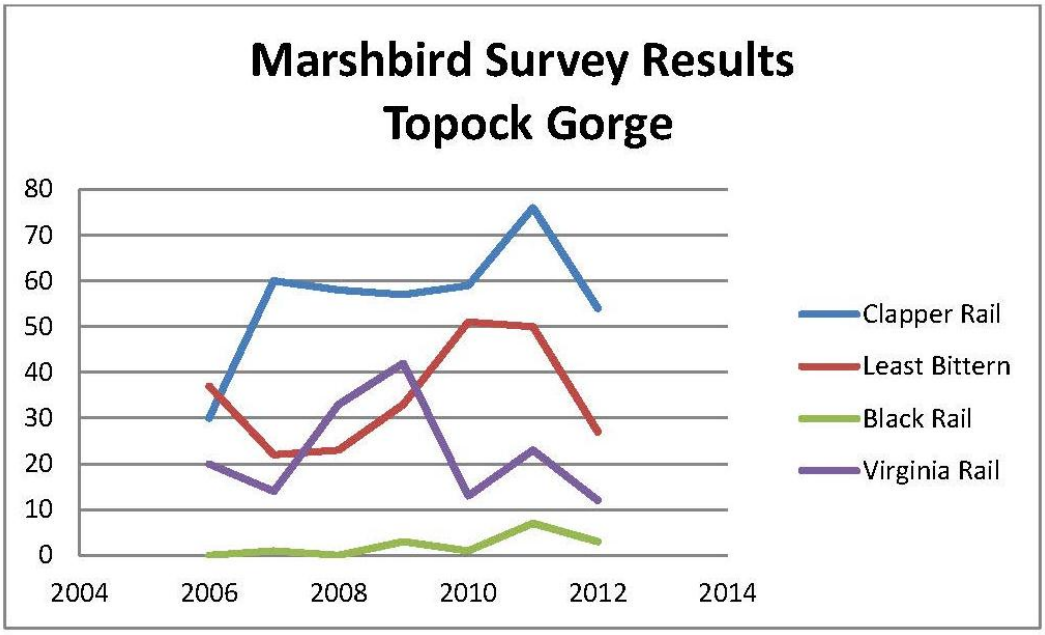

Figure 3.—Marsh bird survey results in Topock Gorge, 2006–2012.

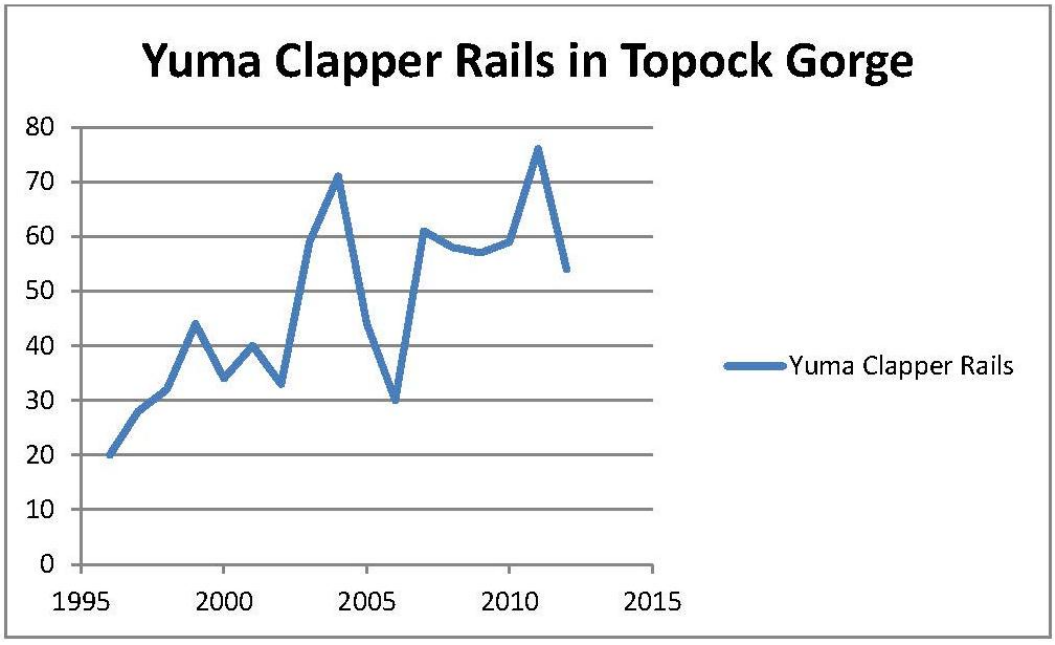

Figure 4.—Yuma clapper rail detections in Topock Gorge, 1996–2012.

Reclamation will continue to coordinate with the USFWS in cataloging areas along the lower Colorado River that are being surveyed. Areas that are not currently being surveyed should be identified and potentially surveyed in the future.

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ATTACHMENT 1

Species List

Birds observed or encountered during marsh bird surveys in 2012
Topock Gorge, Havasu National Wildlife Refuge

		March	April	May
Abert's towhee	*Melozone aberti*			X
American avocet	*Recurvirostra americana*		X	
American coot	*Fulica americana*	X	X	X
American kestrel	*Falco sparverius*	X	X	
Ash-throated flycatcher	*Myiarchus cinerascens*	X	X	X
Barn swallow	*Hirundo rustica*		X	X
Bell's vireo	*Vireo bellii*	X	X	X
Bewick's wren	*Thryomanes bewickii*	X	X	
Black phoebe	*Sayornis nigricans*	X	X	X
Black-chinned hummingbird	*Archilocus alexandri*		X	
Black-crowned night heron	*Nycticorax nycticorax*	X		
Black-necked stilt	*Himantopus mexicanus*		X	
Black-tailed gnatcatcher	*Polioptila melanura*	X	X	X
Blue grosbeak	*Passerina caerulea*	X		
Brewer's blackbird	*Euphagus cynocephalus*	X		
Brown-headed cowbird	*Molothrus ater*		X	X
Bufflehead	*Bucephala albeola*		X	
Cactus wren	*Campylorhynchus brunneicapillus*	X	X	X
California black rail	*Latterallus jamaicensis coturniculus*	X		
California gull	*Larus californicus*		X	
Canvasback	*Aythya valisineria*	X		
Canyon wren	*Catherpes mexicanus*	X	X	X
Caspian tern	*Hydroprogne caspia*		X	
Cinnamon teal	*Anas cyanoptera*			X
Clark's grebe	*Acehmophorus clarkia*			X
Cliff swallow	*Petrochelidon pyrrhonota*	X	X	X
Common gallinule	*Gallinula galeata*	X	X	X
Common loon	*Gavia immer*		X	
Common merganser	*Mergus merganser*	X	X	
Common raven	*Corvus corax*	X	X	X
Common yellowthroat	*Geothlypis trichas*	X	X	X
Crissal thrasher	*Toxostoma crissale*	X		
Double-crested cormorant	*Phalacrocorax auritus*	X	X	

Birds observed or encountered during marsh bird surveys in 2012
Topock Gorge, Havasu National Wildlife Refuge

		March	April	May
Eared grebe	*Podiceps nigricollis*	X	X	X
Forster's tern	*Sterna forsteri*		X	
Franklin's gull	*Leucophaeus pipixcan*		X	X
Gadwall	*Anas strepera*	X		
Gambel's quail	*Callipepla gambelli*	X	X	X
Great blue heron	*Ardea herodias*	X	X	X
Great egret	*Ardea alba*	X	X	X
Greater roadrunner	*Geococcyx californianus*	X	X	
Great-horned owl	*Bubo virginianus*	X	X	
Great-tailed grackle	*Quiscalus mexicanus*	X	X	X
Green heron	*Butorides virescens*		X	X
Horned grebe	*Podiceps auritus*			X
House finch	*Haemorhous mexicanus*	X	X	
Ladder-backed woodpecker	*Picoides scalaris*	X	X	X
Least bittern	*Ixobrychus exilis*	X	X	X
Lesser nighthawk	*Chordeiles acutipennis*		X	X
Lucy's warbler	*Oreothlypis luciae*	X	X	
Mallard	*Anas platryhynchos*	X	X	X
Marsh wren	*Cistothorus palustris*	X	X	X
Mourning dove	*Zenaida macroura*	X	X	X
Northern flicker	*Colaptes auratus*	X		
Northern harrier	*Circus cyaneus*	X	X	
Northern mockingbird	*Mimus polyglottus*		X	
Northern pintail	*Anas acuta*		X	
Northern rough-winged swallow	*Stelgidopteryx serripennis*	X	X	X
Phainopepla	*Phainopepla nitens*	X	X	
Pied-billed grebe	*Podilymbus podiceps*	X	X	X
Redhead	*Aythya americana*	X	X	X
Red-tailed hawk	*Buteo jamaicensis*	X	X	
Red-winged blackbird	*Agelaius phoeniceus*	X	X	X
Ring-billed gull	*Larus delawarensis*	X	X	X
Ring-necked duck	*Aythya collaris*	X	X	

Birds observed or encountered during marsh bird surveys in 2012
Topock Gorge, Havasu National Wildlife Refuge

		March	April	May
Rock pigeon	*Columba livia*	X	X	X
Rock wren	*Salpinctes obsoletus*	X	X	
Ruddy duck	*Oxyura jamaicensis*	X		X
Snowy egret	*Egretta thula*		X	X
Song sparrow	*Melospiza melodia*	X	X	X
Sora	*Porzana carolina*	X	X	
Spotted sandpiper	*Actitis macularius*			X
Summer tanager	*Piranga rubra*		X	
Tree swallow	*Tachycineta bicolor*	X	X	X
Turkey vulture	*Cathartes aura*	X	X	X
Verdin	*Auriparus flaviceps*	X	X	X
Violet-green swallow	*Tachycineta thalassina*	X	X	X
Virginia rail	*Rallus limicola*	X	X	X
Warbling vireo	*Vireo gilvus*	X		
Western grebe	*Acehmophorus occidentalis*		X	X
Western kingbird	*Tyrannus verticalis*		X	
Western wood-peewee	*Contupus sordidulus*			X
White-faced Ibis	*Plegadis chihi*		X	X
White-throated swift	*Aeronautes saxatalis*	X		X
White-winged dove	*Zenaida asiatica*		X	X
Wilson’s warbler	*Cardellina pusilla*			X
Yellow warbler	*Setophaga petechia*		X	X
Yellow-breasted chat	*Icteria virens*		X	X
Yellow-headed blackbird	*Xanthocephalus xanthocephalu*	X	X	
Yellow-rumped warbler	*Setophaga coronata*	X	X	X
Yuma clapper rail	*Rallus longirostris yumanensis*	X	X	X

ATTACHMENT 2

Survey Data Sheet

National Marsh Bird Monitoring Program Survey Data Sheet

Pg___of____

Date *(eg 10-May-04)* **:**

Name of marsh or route :

Observer(s) *(list all)** **:**

Multiple Observer Survey: Y / N

Boat type:

High tide time:

Water depth:

location: location: location:

depth: depth: depth:

List all non-focal species surveyed:

**list all observers in order of their contribution to the data collected*

put an "S" in the appropriate column if the bird was seen, a "1" if the bird was heard, and "1S" if both heard and seen

Station#	Start Time (military)	Temp (C or F *circle one*)	Sky	Wind (Beaufort)	Salinity	Background noise	Species	Responded During										Call Type(s)	Direction	In target area	Distance (meters)	Distance Aide	Detected at a Previous Point	Comments
								Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA	LEBI	VIRA	CLRA	Outside survey period							
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Background noise: 0 *no noise* 1 *faint noise* 2 *moderate noise (probably can't hear some birds beyond 100m)*
3 *loud noise (probably can't hear some birds beyond 50m)* 4 *intense noise (probably can't hear some birds beyond 25m)*

Beaufort scale: 0 *smoke rises vertically* 1 *wind direction shown by smoke drift* 2 *wind felt on face; leaves rustle*
3 *leaves , small twigs in constan motion; light flag extended* 4 *raises dust and loose paper; small branches are moved* 5 *small trees with leaves sway; crested wavelets on inland waters*

Sky: 0 *clear or a few clouds* 1 *partly cloud or variable sky* 2 *cloudy or overcast* 4 *fog or smoke* 5 *drizzle* 6 *snow* 8 *showers*

Distance Aide: 0 *none* 1 *range finder* 2 *distance bands on aerial photo* 3 *surveyor flags tied to vegetation*